

MOSQUITO CONTROL IN THE MUNICIPALITY OF LANE COVE,  
NEW SOUTH WALES.

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(Communicated by Dr. I. M. Mackerras.)

(Plates xlix and l and one Text-figure.)

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*Introduction.*

Mosquito control may be instituted as a prophylactic measure against disease or to abate a nuisance. While there does not appear to be any serious danger from mosquito borne diseases in the area under consideration, mosquitoes were sufficiently abundant to be a public nuisance. A survey was therefore carried out in 1925 and a report, with recommendations, presented to the Lane Cove Council, which authorized a small expenditure enabling control work to be carried out over a limited area. The results obtained were so satisfactory that adequate provision is now made for maintaining this work and extending it to other parts of the Municipality.

Mosquito surveys have been carried out in various parts of New South Wales by Ferguson (1922, 1927*a*) and Mackerras (1926), the last named dealing with the Sydney district as a whole. Control work has also been undertaken more or less thoroughly in several areas, of which Kyogle may be particularly mentioned. This town had in the recent epidemic a dengue fever incidence of 10% as compared with 90% for neighbouring towns in which no control had been attempted (Ferguson, 1927*b*). No description of the methods adopted or the results obtained have, however, been published. Since the local problem has presented some interesting features, it seems desirable that the results of the present investigations should be made available.

I was indebted to the late Dr. Eustace W. Ferguson for determinations and other assistance during the early part of the work.

*Topography.*

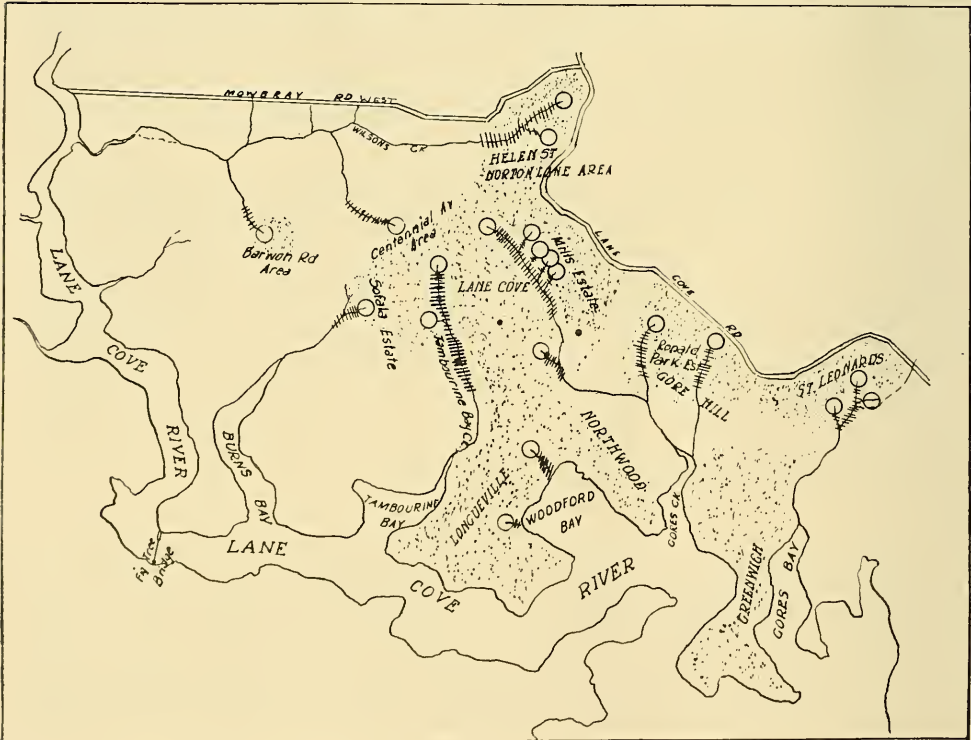
The Municipality of Lane Cove is a suburb of Sydney situated on the northern slopes of Port Jackson. Though only four square miles in extent, it comprises a variety of topographical features. It is bounded on the south and west by the waters of Port Jackson and the Lane Cove River and includes high wind-swept ridges of shale formation, and deeply dissected, shaded sandstone gullies, along which flow permanent creeks, some direct into open bays in the Harbour and some in salt water estuaries fringed with mangroves and headed by reedy brackish swamps.

There is always some flow of water in these creeks even during the driest weather, but in many places they consist of chains of rock pools or small ponds dammed back by sand bars or debris. The foreshores consist partly of precipitous

sandstone cliffs fringed by saline rock pools and partly of mangrove covered mud flats and in some places the low lying rock foreshores slope gently back towards the ridges.

The more elevated parts of the area are more or less densely settled, and only a small section is sewerred, namely the St. Leonards area and portion of the Greenwich area. Over the remainder of the area the greater part of the house drainage eventually flows into the creeks, which are usually set aside as drainage reserves in most subdivided land. This household effluent causes a considerable pollution of the creeks, which extends for a variable distance down stream until removed by aeration, filtration, and dilution by clear water tributaries and the addition of subsoil water. The extent of this pollution, which is the most important factor in the mosquito problem, is shown by cross lines in Text-fig. 1. The extension of sewerage facilities is gradually reducing the amount of pollution, while the institution of pipe drainage has eliminated the pollution in certain areas. Unfortunately, however, the trouble caused by the presence of organic pollution is not entirely eliminated by the institution of pipe drainage, though it may transfer the point of outlet of the drainage to a more remote and less settled area except in cases where the pipe line terminates in tidal waters.

LANE COVE



Text-fig. 1. Map of the Municipality of Lane Cove. The area of denser settlement is stippled, the points of pollution of the creeks are shown by circles, and the extent of pollution by small cross lines.

*Results of the Survey.*

The following ten mosquitoes have been found in the district:

*Culex fatigans* Wiedemann.—This species was found to be a serious pest in the densely settled areas, frequenting the dwellings in and around the business and shopping centres to the detriment and inconvenience of the residents. The factors governing the prevalence of this species are dealt with fully below.

*Aedes (Ochlerotatus) vigilax* Skuse.—Specimens were taken in the bush gullies. It does not occur in the vicinity of dwellings in sufficient numbers to warrant attention. It is not uncommon in the bush, but certainly does not appear to be nearly so prevalent as it is in other parts of the Sydney district.

*Aedes (Ochlerotatus) flavifrons* Skuse.—Only two specimens of this species have been taken, one biting about midday in June and one in the late afternoon in October, 1927, in bush gullies.

*Aedes (Finlaya) alboannulatus* Macquart.—Larvae have been taken in soakage pools and creek ponds, and on rare occasions in slightly stagnant and polluted water. The adult appears to be more numerous in the bush than *Aedes vigilax*, and it attacks viciously in such situations, but does not seem to be a pest in houses.

*Aedes (Finlaya) queenslandis* Strickland.—Adults were taken occasionally in shaded gullies.

*Aedes (Finlaya) notoscriptus* Skuse.—Adults were taken occasionally in houses. Larvae were first taken in a small collection of rain water in an artificial container. This water became very warm with the sunlight and contained a quantity of decaying gum tree leaves. Similar collections of water have been found to favour the breeding of this species.

*Aedes (Pseudoskusea) concolor* Taylor.—Larvae were found in saline littoral pools at Greenwich in water with a high temperature due to direct sunlight, whilst there was also a crust of salt forming around the edges of the pools. It does not frequent houses.

*Lutzia halifaxi* Theobald.—Larvae have been taken in clear rock pools in the creeks, usually in company with larvae of *Aedes alboannulatus*, on which it is a predator.

*Culex (Neoculex) fergusonii* Taylor.—Larvae were collected in a clear rock pool in the bush near Fig Tree. It was very plentiful on the occasion of the first visit. A few days later no larvae in any stages of development were found, but larvae of Zygoptera had become numerous.

*Anopheles annulipes* Walker.—Adults were shy biters and rarely met with. In fact on only one occasion was a specimen observed on the wing. Adults were found trapped on an oil film in a small soakage pool. Larvae have been taken in clear water, in small numbers, and in fairly large numbers in early summer in more or less muddy pools in company with *C. fatigans*.

From these findings it was apparent that *Culex fatigans* was the only species requiring serious attention and it was decided from the point of view of economy and efficiency to limit all attempts at control strictly to this species. It was further considered desirable that adequate control should be obtained on Council lands before attempting any house to house campaign.

The problem was to deal with *C. fatigans* breeding in natural collections of water such as in creeks and drainage easements rather than in artificial collections of water.

The dominant factor determining the extent of the breeding of *C. fatigans* in all creeks and drainage easements was found to be the extent of the pollution.

In clear unpolluted water numerous predatory aquatic insects were found and *C. fatigans* was absent, except at the very beginning of the season before predatory life became abundant.

In only one instance, where natural waters were polluted, was it found that larvae of *C. fatigans* were not present at some time during the season. In this particular case a large dam used for manufacturing purposes received heavy organic pollution from the waste water returning from the machines, and the fact that kerosene oil, which is used largely in the manufacturing process, gained access to the dam undoubtedly accounted for the absence of larvae of *C. fatigans*.

In all other instances, however, the drainage-polluted bodies of water in the creeks and drainage easements were found to be prolific sources of the breeding of *C. fatigans*, and as these drainage easements and creeks came directly under the Council's control the work of control under such conditions was decidedly a Council matter.

After the measures of control instituted by the Council became properly established, the only instance where mosquitoes were reported to be on the increase, was found on investigation to be due to a septic tank effluent gaining access to the surface of the ground, due to faulty rubble absorption drains. With the reconstruction of the rubble drains, and the effectual disposal therein of the septic tank effluent, no further complaints were received.

That the presence of pollution due to a high content of organic nitrogenous and other waste products was found to be favourable to the breeding of *C. fatigans*, was indicated by the presence in large numbers of these larvae in the effluent of the septic tank previously mentioned. In that case the effluent was seen to be flowing over the ground surface for about 30 yards with a width of about 4 feet, terminating in a grass covered area of several square yards. Here small pools had been formed and each pool was found to contain hundreds of larvae of *C. fatigans*.

Naturally such breeding areas would contain no aquatic predators, and there is further evidence to indicate that both the type of nutriment and the absence of predators determine the selection of breeding grounds by this species. This was clearly demonstrated in one case, where three large ponds in a disused quarry were inspected at various intervals during the season. No mosquito larvae were found until towards the end of the season, when a rain storm carried a certain amount of house drainage into one pond, and when visited about a week later, this particular pond was found to contain enormous numbers of larvae of *C. fatigans*, whilst the other unpolluted ponds remained free from mosquito larvae.

#### METHODS OF CONTROL.

##### *Oiling.*

Oil spraying was carried out only in correlation with the extent of pollution; that is from the point of origin of pollution to the point where the presence of gill breathing animals or insects indicated the elimination of organic putrescible matter. In some cases this line of demarcation was fairly definite, as for instance where at the end of a run of several hundred yards the water filtered through a large natural sand filter in the form of a sand bar, or where a small drainage easement entered a fast moving stream with a greater volume of water. Sometimes, however, it was not so definite, but the operator soon became skilled in the work of oiling in such a manner as to produce the best results with the least amount of damage to useful or harmless forms of life.

*Plant.*

The plant provided at the commencement of the season was rather obsolete, and for want of staff the maintenance staff were given the work of oiling. Even under such conditions favourable results were obtained, and at the commencement of the following season two knapsack sprays and a horse and vehicle (the latter in place of the wheelbarrow formerly used to transport equipment and oil) were provided. The entire work was then given to one man engaged as a weekly hand, his sole duties being that of mosquito eradication.

The results from then on were very satisfactory and mosquito control is now looked upon by the Council as part of its ordinary duties, the Council no longer allowing mosquitoes to breed on any country over which it has direct control.

This has placed the Council in the happy position of being able to guide and direct the residents and ratepayers to take the necessary steps to rid their premises of mosquitoes without themselves being the subject of adverse comment.

*Channelling and Clearing.*

The termination of the oil spraying at the end of last summer did not end the Council's activities in the work of mosquito control. As the result of a recommendation the same weekly hand previously engaged on the spraying work was employed on the work of channelling and clearing the drainage easements and watercourses on which summer control measures had been adopted. It is a well-known fact that *C. fatigans* seeks fairly still or sluggish water, and is also very partial to shaded situations for breeding purposes, and, while the clearing and channelling work will undoubtedly tend towards greater efficiency in mosquito control during the coming season, it is also a sanitation measure which has long been overlooked. Ponds of polluted water have been eliminated whenever possible by channel cutting and in some localities rock channels have been made by blasting with gelignite. Logs and debris have been removed and drainage polluted swamps eliminated. From observations made during the following twelve months on channels cut during the summer of 1926, there is every indication that a well cut channel will require very little maintenance in this district besides greatly reducing the expenditure on oil (Plate 1, fig. 4).

*Educational.*

With a view of enlisting the co-operation of the residents and in the interests of propaganda work on mosquito control, the Council accepted a recommendation to provide the necessary equipment in the way of a projecting lantern and suitable lantern slides to enable the writer to lecture to several local audiences. In this respect every assistance and courtesy has been shown by the various head masters of the schools and the leaders of other local organizations. The exhibition of lantern slides at the local picture theatre free of charge has been due to the interest and kindness shown by the proprietor to whom thanks are due.

*Experiments with Automatic Oil Stations.*

Drip oilers made from empty tins were found to be unsuitable, due to the unwanted attention from the ubiquitous small boy. Bags of sawdust saturated with oil, and submerged in the various drainage easements were not effective owing to the excessive amount of solids and grease present in the drainage forming an impervious scum around the bags.

*Laboratory Experiments.*

Crude oil was found in laboratory experiments to be too heavy and flocculent, allowing a clear area to form at the edge of the jar containing the larvae, and it was also noticed that the larvae were capable of living beneath the oil film for a period of three days. Close observation also showed that they were capable of piercing the film, with their siphons, and on descending from the surface minute pin holes were observed in the film.

An unrefined kerosene known as Solar oil produced efficient larvicidal results in 13 minutes.

A mixture of equal parts of Solar oil and tar oil produced the desired results in 7 minutes. The tar oil used without the kerosene oil did not form as complete a film as when the two oils were mixed.

As a result of these experiments the Council is now using a mixture of three parts of unrefined kerosene and one part of tar oil in the field and the effects are being carefully noted.

*List of Former Prolific Breeding Grounds of Culex fatigans.*

Phoenix Street at the outlet of drainage from Mills Estate was the first area treated. Approximately 100 houses drain into the drainage easement at this point. Here, prior to operations, the water immediately below the point of pollution was dense with larvae, whilst a natural rock shelter near by was seen to be sheltering myriads of the adult mosquitoes. (Plate xlix, fig. 2.)

From Little Street a drainage easement received drainage from the premises on the eastern side of the shopping centre at the Lane Cove tram terminus, and this easement for a distance of several hundred yards, together with two subsidiary easements, formed another prolific source of mosquito breeding.

The drainage easements in the Helen Street-Norton Lane area were formerly the origin of swarms of adult mosquitoes. (Plate l, fig. 1.)

Tambourine Bay Creek required considerable attention for several hundred yards down stream from the point of pollution. (Plate l, fig. 3.)

Sofala Estate drainage which discharged into the Trouve Street drainage easement, was effectually treated.

The Ronald Park Estate drainage easement, formerly ideal for mosquito breeding, is now free from the pests.

Centennial Avenue and Barwon Creek have also been successfully treated, whilst many other small unnamed drainage easements have received their quota of expenditure.

*Summary of the Work and its Results.*

There is every indication that the work has been economically sound from a Local Government expenditure point of view and will therefore be continued in the future, whilst from a health and convenience standpoint there is every indication that the residents have greatly benefited. In this respect one is inclined to believe, judging by the benefit felt by residents at some considerable distance from former breeding areas, that the range of flight of *Culex fatigans* is considerably greater than previously thought by workers in sanitary entomology.

## EXPLANATION OF PLATES.

## Plate xlix.

1. Pipe drain pouring polluted house drainage into a creek.
2. The pool to the left was heavily polluted and contained large numbers of larvae, while myriads of adult *C. fatigans* were found sheltering under the overhanging rock to the right of the picture.
3. A pool of still, clear water above the entry of the house drainage. No larvae of *C. fatigans* were found here.
4. A small swamp in the course of a creek far enough below the point of pollution for the water to have become again clarified. No larvae of *C. fatigans* were found here.

## Plate I.

1. A small heavily polluted pool in which large numbers of larvae of *C. fatigans* were found.
2. The same pool as shown in Plate I, fig. 1, after channelling and clearing had been carried out.
3. A channel cut further down the creek where it runs in a sandstone gully.
4. An area which had been channelled and cleared twelve months before the photograph was taken, during which time it had received no attention whatever.

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